Accurate Time & Frequency System

Model AR76A

GPS-Disciplined Rubidium/OCXO Clock

Key features:

- *Frequency Accuracy : 1E-12*
- *1PPS Accuracy: 20ns RMS*
- *Holdover: 1µs/24 hours, 5E-11/month*
- *20 outputs (10MHz, 1PPS, TOD)*
- *LAN IPV4 (NTP V3, Monitor & Control, DHCP)*
- *External 1PPS / Frequency input for disciplining*
- *12 channel C(A) code GPS receiver*
- *Front Panel Display (Time, Date, BIT and more)*
- *Monitor & control: RS232, UDP*
- *Supply Voltage: 90/260 VAC*
- *Delay Correction for Input & Output*

Options:

- *Up to 3 channels LAN interface*
- *SNMP Monitor & Control (Custom MIB)*
- *IEEE 1588 / PTP Grandmaster*
- *DDS - Up to 30MHz, 32 bit resolution*
- *Supply Voltage: DC or DC&AC*
- *Graphic User Interface (GUI) Software for PC*
- *TOD Format: IRIG-B,NMEA,IRIG-A, NASA-36*
- *P(Y) code SAASM GPS receiver*

Description

The AR76A is a multi-function GPS Disciplined Rubidium Atomic Clock, which provides accurate time & frequency. The AR76A incorporates numerous features into a single box, including a Rubidium Frequency Standard, an internal C/A code 12 channels GPS receiver, and an input from external 1PPS / frequency.

The various options of the unit include a variety of different frequencies and several Time Codes outputs. The Rubidium Standard functions as a local oscillator and is phase-locked to the GPS or to external inputs. All outputs are derived from the Rubidium Clock, which maintains accurate time and frequency when GPS or other inputs are interrupted. For low cost applications an Oven Control Crystal Oscillator (OCXO) is offered instead of Rubidium Frequency Standard.

The unit includes up to three physical LAN interfaces boards, which support UDP / SNMP for management and for NTP (Network Time Protocol). The three LAN boards can be used for three different networks (with three different IP network addresses), or for two networks where the 3rd LAN board is reserved as a redundant back-up. A Precision-Time Protocol (PTP) is available with one of the LAN board. The AR76A provides multiple outputs: 10 coax outputs, two fixed (10MHz and 1PPS) and 8 configurable outputs which can be selected from 1PPS, 10MHz, and more.

Additional outputs are available on the D-Type connector including differential RS422 outputs, TOD (Time Of Day) outputs with several standard protocol like NMEA, IRIG B etc' and more. The unit is 19" x 1U rack-mountable encasement.

***Note:** Have-Quick Time Code and an option for P(Y) SAASM GPS receiver are available in model AR77A. Contact factory for details.*

Applications

Test Equipment	Telecommunication	Cellular Base Stations
Scientific Equipment	Secure Communication	Mobile Radio Base Stations

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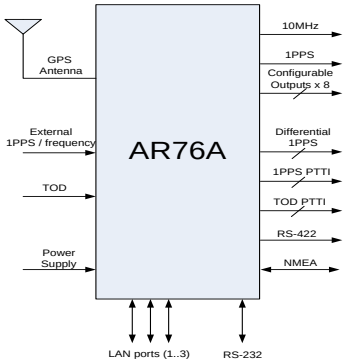
		Basic Configuration	Options (*)
Outputs	BNC Connectors	* 5 x Sine Wave (10±2 dBm) * 5 x 1PPS (TTL/50Ω) The user can set other outputs configurations (see S/W ICD)	Other combinations of the following signals are available upon request: **Frequency:** 1MHz, 5MHz, 2.048MHz (sine or square) and others **DDS frequency:** 1KHz – 30MHz **TOD:** IRIG B (additional formats are also available) , Have Quick, NMEA
	44 pins D Type Connector		Other combinations of the following signals are available upon request : **Frequency:** 1MHz, 5MHz, 2.048MHz (sine or square) and more other frequencies **DDS frequency:** 1KHz – 30MHz **TOD:** NMEA * 4 x 1PPS (RS-422) * 2 x 10MHz (RS-422) * 4 x 1PPS (ICD-GPS-060) * 5 x TOD ICD-GPS-060 -Have Quick * H/W BIT (open collector)
Inputs	BNC Connector	For Time and Frequency Disciplining: • 1PPS (TTL/50Ω or ICD-GPS-060) • 10MHz	**Frequency:** 1MHz, 2.048MHz, 5MHz and more **TOD:** IRIG B (more formats are available as well)
	44 pin D Type Connector		**TOD:** NMEA
LAN	• IPV4 • NTP server V3 per RFC1305 ≤ 1ms, each LAN board can support up to 1100 NTP requests per second • DHCP • Control & Monitoring (UDP)		• IEEE 1588 / PTP – Grandmaster / slave (one output) • Up to 3 independent LAN ports (3 NTP servers or 2 NTP servers and one PTP) Each one has a different IP address serving three separates networks • SNMP V3 (Custom MIB)
CLI	RS-232 port (single ended or RS-422) remote control		

(*) Contact factory for detail



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Performance (with Rubidium Frequency Standard as the local oscillator)

Mode of work		**Disciplined to GPS or to external 1PPS**	**Free running Rubidium**
Time (1PPS)		20ns RMS relative input	1 µs/ 24 hours (typical) After 24 hours of disciplining
Frequency	**Long Term Stability**	≤ 1E-12	≤ 5E-11 / month
	Short Term Stability (ADEV)	**Standard**	**Improved (option)**
		3E-11 @ 1s 5E-12 @ 100s	Contact factory for information
	Temperature Stability	±3E-10 over -20°C to +65°C	
	Phase Noise (*) (@ 10MHz)	**Standard (typical)**	**Improved (option)**
		≤-80dBc/Hz @ 1Hz ≤-114dBc/Hz @ 10Hz ≤-140dBc/Hz @ 100Hz ≤-146dBc/Hz @ 1KHz ≤-147dBc/Hz @ 10KHz	Contact factory for information
	Harmonics (*) (10MHz)	≤ -48dBc	
	Spurious (*) (10MHz)	≤ -100dBc @±100KHz	
	Warm-up time	Rubidium Lock < 4 minutes 5E-11 within < 60 minutes 1E-11 within < 4 hrs 1E-12 within < 24 hrs	

(*) The above figures are given for the J17 output. Some degradation may occur for other outputs.

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GPS C(A) Code Receiver	
GPS Tracking	L1 frequency 1575 MHz C/A code (SPS), 12 parallel tracking channels
Ephemeris & Almanac	Available on 44 pin D Type connector (option)
Position Accuracy	Latitude, Longitude: < 6m (CEP 50%), Altitude: < 11m (CEP 50%)
Acquisition Time (Typical) (*)	Warm start ≤ 45 second, Cold start ≤ 50 second (worst case)
GPS Antenna DC Voltage	5VDC (up to 100 mA)

(*) The acquisition time refers to the GPS receiver output. For frequency stabilization during Warm-up – see above.

Environmental	
Operating Temperature	-20°C to +65 °C
Storage Temperature	-20°C to +70°C
Humidity	Up to 95% at 35°C, non-condensing
Vibration	2.5g RMS

Safety	
Safety Standard	CE (safety)

Power Supply	
Power Supply	90-260 VAC 47/63 Hz (Option: DC power supply 28VDC± 4V, -48VDC)
Power Consumption	< 35W Warm-up , < 20W Steady state
Power Supply Redundancy (option)	Options for power supply redundancy: 1. Two power supply inputs – one for AC and the other for DC 2. Two DC power supply inputs

Front panel display & indications and GUI		
Display	The LCD front panel display and buttons enable the user to view and configure most parameters. The displayed information includes the Time, Date, BIT, GPS parameters (antenna current, satellite status) and more. Configured parameters include time synchronizations source, 1PPS delay, outputs configuration and more. For details see user manual or contact factory. Florescent display is available as an option (instead of the LCD display).	
LED Indications	4 LEDs on the front panel: Power, Overall BOT, TOD Source, 1PPS / FREQ Source	
Graphic User Interface (GUI) – option (The GUI is software for PC used for maintenance and as a starter kit)	○ Time / date display ○ Satellites in view ○ Navigation data from GPS and ○ BIT (Built In Test) ○ Time source & Time zone ○ Leap seconds (from UTC to GPS)	○ IP address configuration ○ Antenna cable delay ○ External input and 1PPS output delay ○ Matrix configuration ○ Time setting GPS / UTC ○ Additional parameters

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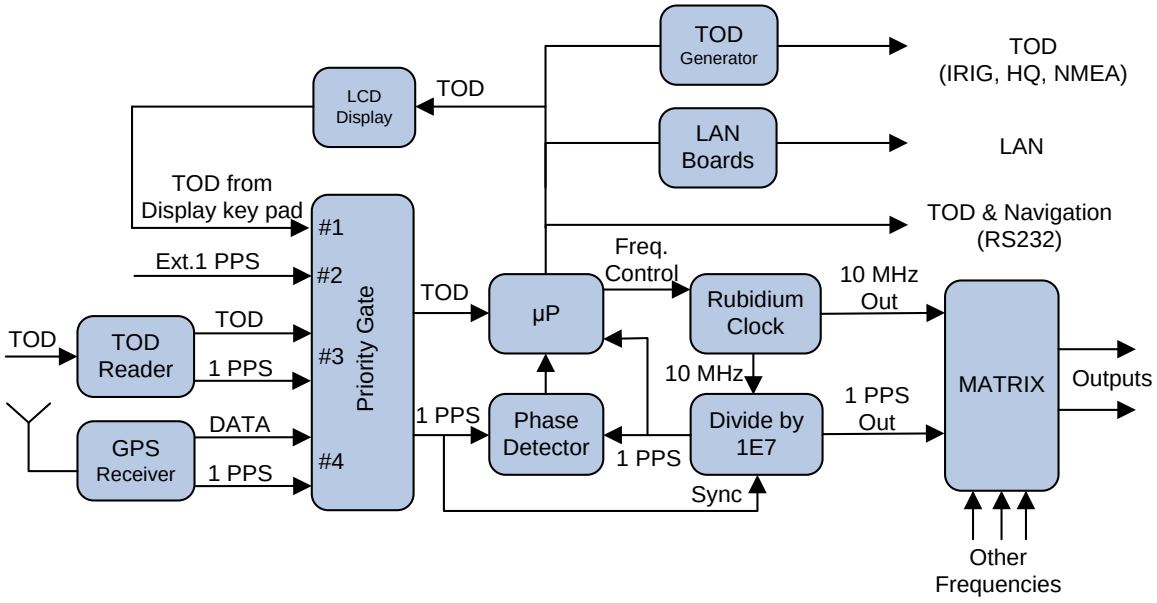
Principles of Operation

The following block diagram describes the operation of the **AR76A.** The unit includes Rubidium Clock and accepts inputs from either internal GPS receiver or external 1PPS & TOD sources. All outputs are derived from the internal Rubidium Clock, which is phase-locked via a digital PLL to the internal GPS receiver or to one of the external inputs. This way, the Rubidium Clock follows the GPS long term accuracy and cleans the jitter and the noise on the short and medium terms. When the GPS reception is lost, for short or long periods of time, the Rubidium continues to maintain accurate time and frequency.



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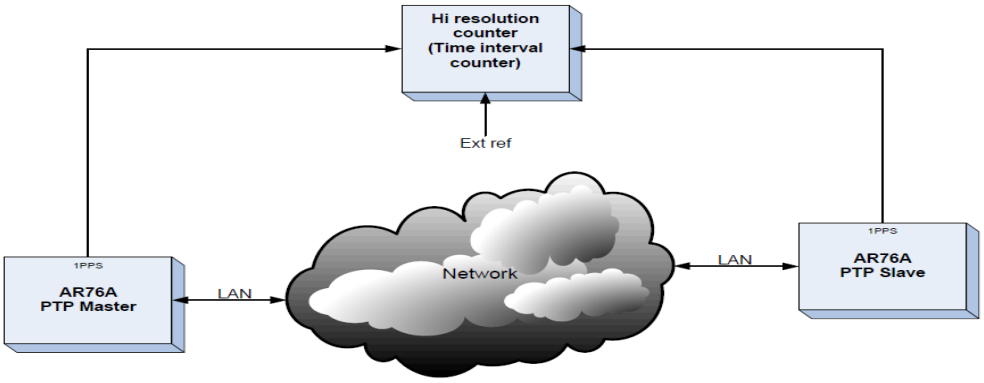
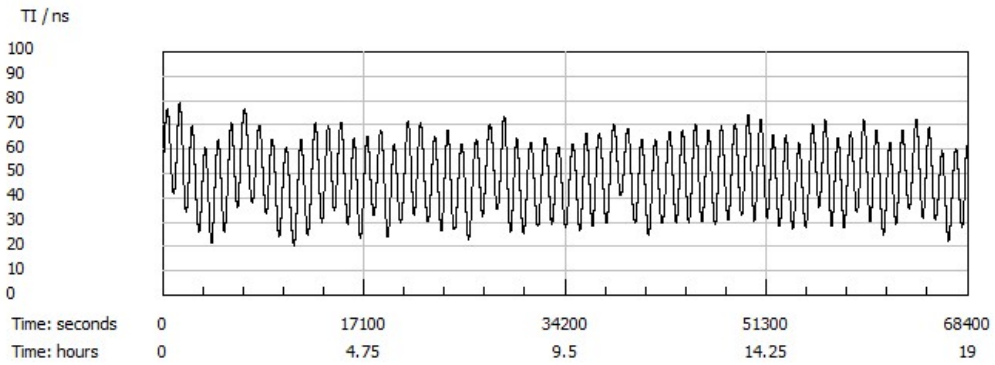
Precision Time Protocol – PTP (option)

- IEEE-1588-2008 V2 PTP Grandmaster/Slave
- Multicast / Unicast modes of operation
- UDP/IPv4 (L2 or L3)
- Design to handle up to 200 slaves simultaneously
- Accuracy: ≤1µs (network dependency)

In the following figure, two AR76A units are interconnected via a network (one as a master and one as a slave). The time interval between the two 1PPS outputs was measured over time and the results are shown in the plot below.

PTP performance measurement setup





Time accuracy < 50ns RMS

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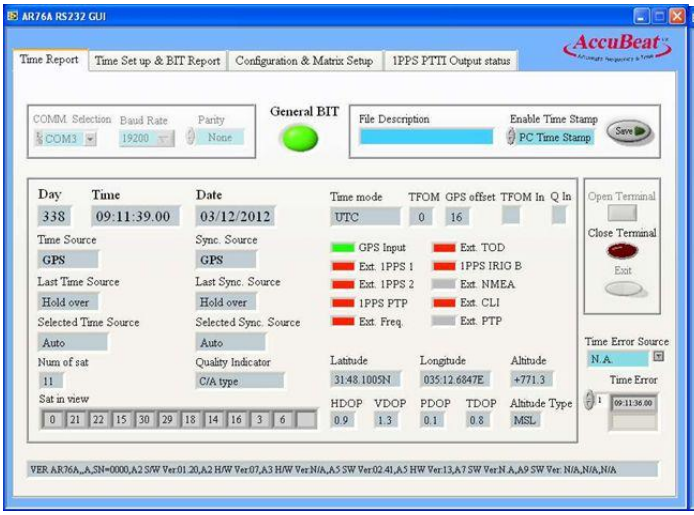
Performance (with OCXO as local oscillator instead of Rubidium)

Mode of work		**Disciplined to GPS or to external 1PPS**	**Free running Rubidium**
Time (1PPS)		100ns RMS relative input @ 25°C	1 ms/ 24 hours (typical) After 24 hours of disciplining.
Frequency	**Accuracy**	≤ 1E-11	≤ 2E-8 / month (after 30 days of operation)
	Short Term Stability (ADEV)	3E-11 @ 1s	
	Temperature Stability	±200 ppb over -20°C to +70°C	
	Phase Noise (10MHz) (*)	≤-85dBc/Hz @ 1Hz ≤-115dBc/Hz @ 10Hz ≤-130dBc/Hz @ 100Hz ≤-135dBc/Hz @ 1KHz	
	Harmonics (10MHz) (*)	≤ -48dBc	
	Spurious (10MHz) (*)	≤-100dBc @±100KHz	
	Warm-up time	1E-11 within < 24 hrs	

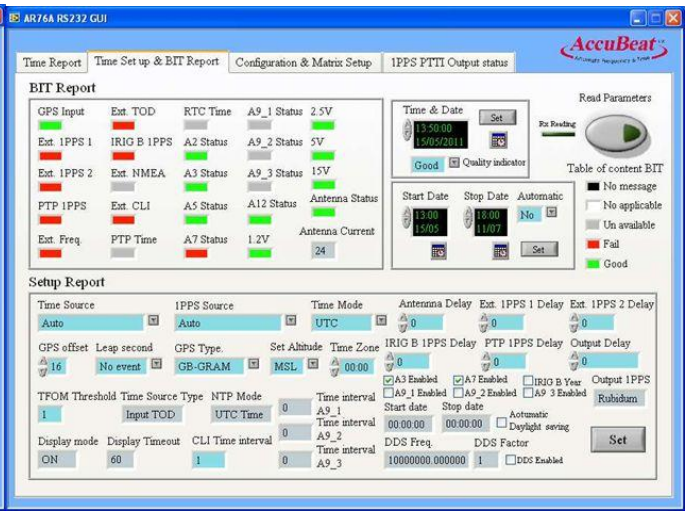
(*) The above figures are given for the J17 output. Some degradation may occur for other outputs.

AR76A GUI

Time report screen



BIT Report screen



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Electrical ICD

Connector	Description	Standard Type	Options
J1	Power supply	AC, Standard Inlet (IEC320)	28VDC / -48VDC
J2	GPS antenna	TNC, Female	
J3 – J5	LAN	RJ-45	
J6	CLI	D9, Female	
J7	Additional I/O	D type, 44 pin, Female	
J8 – J17	Coax outputs	BNC, Female	TNC, Female
J18 - J19	Inputs	BNC, Female	TNC, Female

J6 – RS-232 communication to PC - 9 pin D type connector signals:

Pin Number	*Function*	
2	CLI-Tx (to PC)	RS-232, 19,200 baud rate, 1,8,1 no parity (default)
3	CLI-Rx (from PC)	
5	GND	
1, 4, 6, 7, 8, 9	Not used	

J7 – Auxiliary Time, Frequency, communication and miscellaneous - 44 pin D type connector signals:

With this connector the customer can get additional outputs such as: 1PPS, 10PPS (and more, TTL or RS-422), additional square-wave frequencies (TTL or RS-422), TOD (Time of Day) in NMEA or IRIG B (DC) or other formats, CLI communication in RS-422 and Overall BIT indication.

Please note that in the table below, outputs of pins 6 – 13, 16 – 19, 26 – 30 and 32 – 35 are offered as option.

Pin #	*Function*		*Pin #*	*Function*
1	CLI_IN RS422+		23	GND
2	CLI _IN RS422-		24	FACTORY USE (Lock signal)
3	CLI _OUT RS422+		25	GND
4	CLI _OUT RS422-		26	TOD #1 (TTL / 100kohm)
5	GND		27	TOD #2 (TTL / 100kohm)
6	X_PPS_RS422+ output (#1)		28	TOD #3 (TTL / 100kohm)
7	X_PPS _RS422- output (#1)		29	TOD #4 (TTL / 100kohm)
8	Y_PPS _RS422+ output (#2)		30	TOD #5 (TTL / 100kohm)
9	Y_PPS _RS422- output (#2)		31	GND
10	Z_PPS _RS422+ output (#3)		32	1PPS #1 (TTL / 50ohm) output
11	Z_PPS _RS422- output (#3)		33	1PPS #2 (TTL / 50ohm) output
12	W_PPS _RS422+ output (#4)		34	1PPS #3 (TTL / 50ohm) output
13	W_PPS _RS422- output (#4)		35	1PPS #4 (TTL / 50ohm) output
14	GND		36	Over all BIT (open collector), < 100mA Low = OK, High impedance = fail
15	5.5V (internal 300Ω series resistor)		37	GND
16	AUX Frequency RS422 OUT+ (#1) Default: 10MHz		38	FACTORY USE
17	AUX Frequency RS422 OUT - (#1) Default: 10MHz		39	
18	AUX Frequency RS422 OUT + (#2) Default: 10MHz		40	

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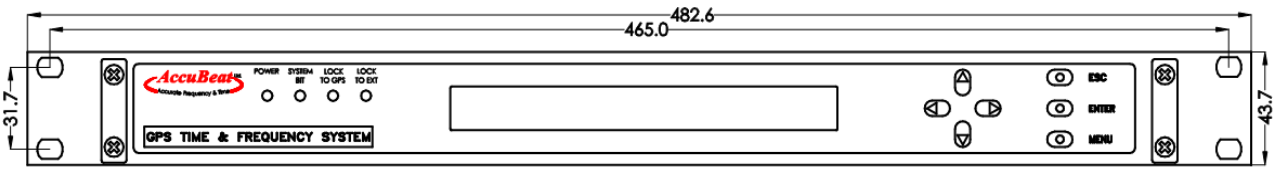
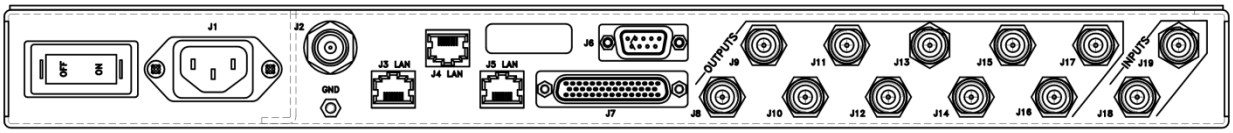
Pin #	Function		Pin #	Function
19	AUX Frequency RS422 OUT - (#2) Default: 10MHz		41	
20	GND		42	
21	NMEA_RxD_RS-232		43	
22	NMEA_TxD_RS-232		44	

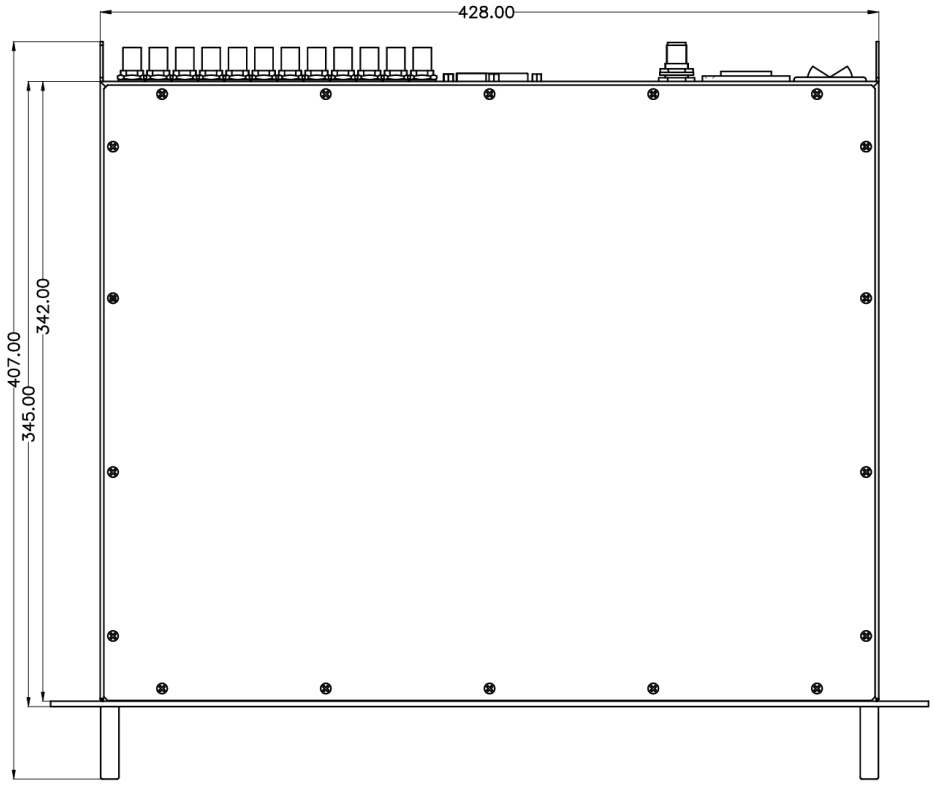
Mechanical ICD



Front panel



Rear panel



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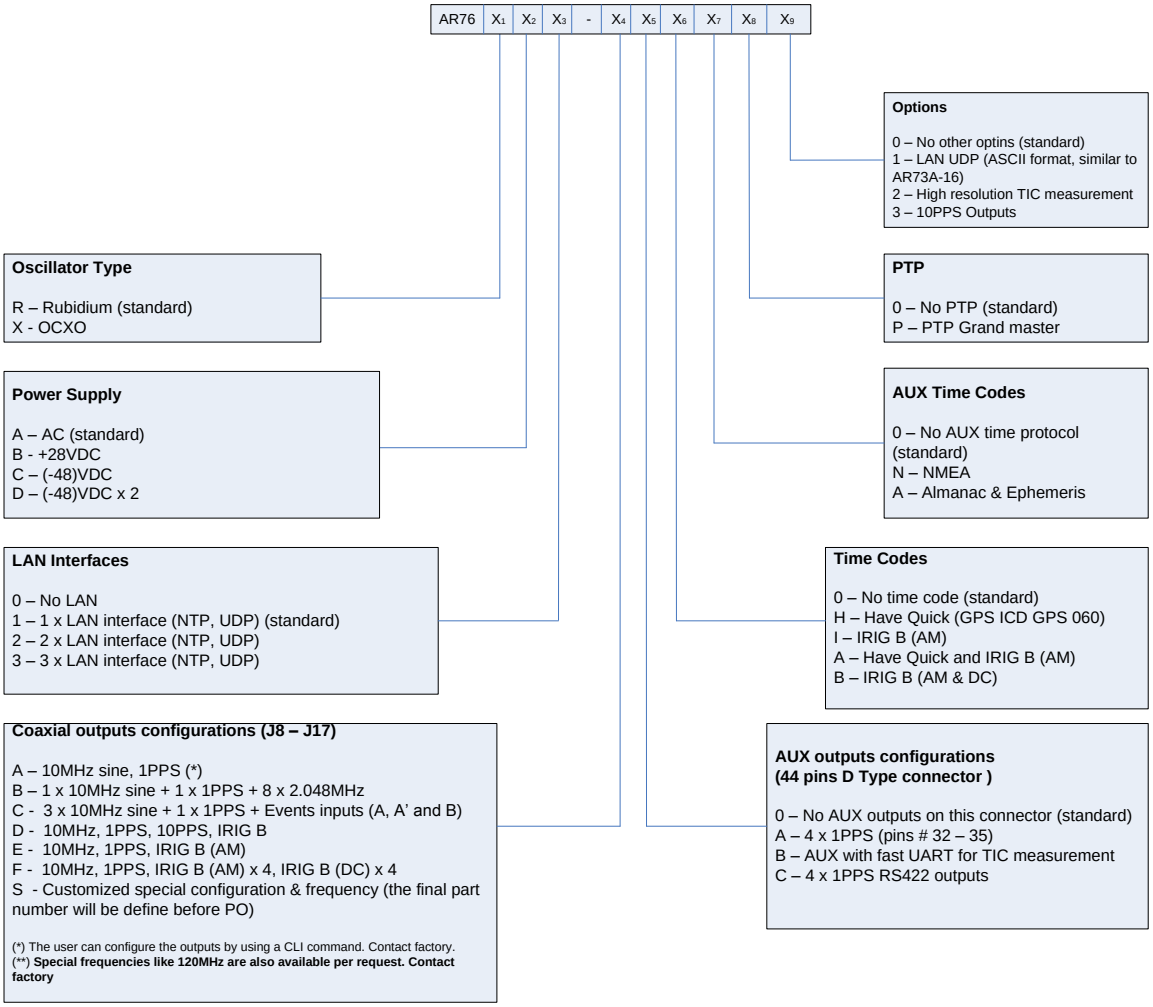
HOW TO ORDER:


AR76 X1 X2 X3 - X4 X5 X6 X7 X8 X9
Options
0 – No other optins (standard)
1 – LAN UDP (ASCII format, similar to AR73A-16)
2 – High resolution TIC measurement
3 – 10PPS Outputs
Oscillator Type
R – Rubidium (standard)
X - OCXO
PTP
0 – No PTP (standard)
P – PTP Grand master
Power Supply
A – AC (standard)
B - +28VDC
C – (-48)VDC
D – (-48)VDC x 2
AUX Time Codes
0 – No AUX time protocol (standard)
N – NMEA
A – Almanac & Ephemeris
LAN Interfaces
0 – No LAN
1 – 1 x LAN interface (NTP, UDP) (standard)
2 – 2 x LAN interface (NTP, UDP)
3 – 3 x LAN interface (NTP, UDP)
Time Codes
0 – No time code (standard)
H – Have Quick (GPS ICD GPS 060)
I – IRIG B (AM)
A – Have Quick and IRIG B (AM)
B – IRIG B (AM & DC)
Coaxial outputs configurations (J8 – J17)
A – 10MHz sine, 1PPS (*)
B – 1 x 10MHz sine + 1 x 1PPS + 8 x 2.048MHz
C - 3 x 10MHz sine + 1 x 1PPS + Events inputs (A, A' and B)
D - 10MHz, 1PPS, 10PPS, IRIG B
E - 10MHz, 1PPS, IRIG B (AM)
F - 10MHz, 1PPS, IRIG B (AM) x 4, IRIG B (DC) x 4
S - Customized special configuration & frequency (the final part number will be define before PO)
(*) The user can configure the outputs by using a CLI command. Contact factory.
(**) Special frequencies like 120MHz are also available per request. Contact factory
AUX outputs configurations (44 pins D Type connector)
0 – No AUX outputs on this connector (standard)
A – 4 x 1PPS (pins # 32 – 35)
B – AUX with fast UART for TIC measurement
C – 4 x 1PPS RS422 outputs

Note: *P(Y) SAASM GPS receiver are available in model AR77A. Contact factory for details.*